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SOME COMMON NEW MEXICO PLANT DISEASES

By
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NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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SOME COMMON NEW MEXICO PLANT DISEASES

INTRODUCTION.

The purpose of this bulletin is to furnish to the people of the State such information as will enable them to understand the nature of plant diseases, to recognize them as they occur in the orchard, garden, or field, and to apply the best and most effective control measures.

New Mexico crops, of garden, orchard and field, are not troubled with as many fungous diseases as are those of States which have a more moist climate. It is best that we keep on the watch for the first appearance of fungous diseases in the State. In many cases, the immediate suppression of a disease that has been introduced may mean the saving of thousands of dollars to a locality. The Department of Biology of the Experiment Station will be ready at all times promptly to identify plant diseases that are sent in, and suggest remedies.

ALFALFA

LEAF SPOT.—Among the diseases of the foliage of the alfalfa plant, the one which is most widely known and is reported to cause the greatest loss is alfalfa leaf spot.

The leaves first show small brown spots, irregular or circular, which extend through the leaf and are thus visible from both sides. The lower leaves and leaves of the older plants are most subject to leaf spot. Badly diseased leaves turn yellow and fall off. Plants late in the season, as of the second and third cuttings, suffer more than earlier in the season. These crops, especially in a dry season, if allowed to stand too long before cutting, may be badly spotted and the loss of hay through fallen leaves may be considerable. The plants are never killed by this disease, although young fields which have not yet become well established may be ruined.

The only practical treatment is to mow down badly diseased plants with the hope that the new shoots which spring forth may overcome the disease. If the disease appears just before cutting time, the mowing should be hastened a few days in order to avoid loss from leaf shedding.

ALFALFA STEM NEMATODE.—The parasitic eelworm, known as the alfalfa stem nematode, a comparatively new disease in the United States, has been found recently in one section of the State. It is very destructive, reducing the alfalfa crop to a poor stand of dwarfish plants, and should the disease spread, it may become a serious menace to the alfalfa growers of the State.

The disease is manifested by the thinning out of the alfalfa in

spots in the field, due to some of the plants dying. This leaves a poor stand of dwarfed plants with a reduced number of stems, some of which may be more or less yellowed and distorted. The parasite causes the alfalfa stems to wilt in early stages of the disease, and may be recognized by this characteristic. A close examination of affected plants shows that the disease is localized in the crown of the plant. Stems are swollen at the base and brown in color. They are often brittle and easily break off; in fact, this brittleness is one of the means of easy diagnosis. New buds and sprouts arising from the crown may be swollen, pale yellow or cream colored, and of a spongy texture. Rapidly growing, succulent shoots that are affected are often swollen at their tips, or may have swollen side shoots, thus carrying the disease from a few inches to a foot or more above ground.

The surest symptoms by which the eelworm disease may be recognized are the swollen buds and sprouts and the enlarged stems. Badly diseased plants show a distinct rotting of the stem bases and crown, with some or all the stems completely killed. The rot in such plants extends into the roots, hence the names "stem-rot" and "root-rot" which are sometimes applied to the disease.

The spring of the year is the best time to look for the disease. A favorable time for a survey is the period of two or three weeks after the new growth has obtained a good start, following a cutting.

The disease may be carried long distances by irrigation water, or by hay. Waste water from infected fields carries the organisms by the millions. The spread over the shorter distances may be accomplished by farm implements or by animals and man, any one of which may carry bits of the diseased plants containing many eelworms or their eggs. In hay the organisms show their remarkable resistance to drying.

The safest way, especially from the point of view of the owners of alfalfa lands that are free from the disease, is to eradicate the disease wherever it occurs. This will involve the plowing up of the affected fields and devoting them to other crops for at least three years. This gives time to starve the organisms completely. The removal of alfalfa must be complete, otherwise enough of the organisms will be held over alive to bring about new centers of infection when alfalfa is again planted. After doing the work of eradicating the alfalfa in an infected field, all tools and implements used should be thoroughly cleaned and disinfected.

APPLE

SCAB.—Scab affects the fruit, leaves, and twigs but is rarely found on the twigs except in cases of a few very susceptible varieties.

On the leaves, the first appearance of the disease in the spring

is indicated by an irregular, faint olive-brown spot on the under surface of the leaves. Later, spots more regular in outline appear on the upper surface of the leaves. On the fruit the spots are at first small, brown and smooth but later they become cracked and rough. In severe cases of infection the spots may unite, forming a russeted area on one side of the fruit, and, by checking the normal development, cause a deformed fruit.

All varieties of apples are subject to this disease, and although some are notoriously susceptible, others are regarded as almost immune. The Jonathan, Grimes, and King David are quite resistant, while the Ben Davis, Gano, Rome Beauty, and Delicious are very susceptible.

Control measures consist in spraying the trees with a 4-4-50 Bordeaux mixture spray. This spray should be applied just before the blossoms open, again just after the petals fall, followed by one or two later sprayings. Burning of infected leaves is a good sanitary measure.

APPLE MEASLES.—The disease known as apple measles is extremely variable in its occurrence. In general it may be stated that there are three more or less distinct types of the disease. As a matter of convenience, these may be designated as the isolated pimply type, the aggregate pimply or scurfy type, and the canker type. The disease first appears as scattered red pimples on the young smooth bark. These pimples are generally a light red near the outside and nearly black at the middle. As the disease progresses the pimples become more numerous until the limb is covered with them, making the bark very rough or producing cankers.

There is considerable difference in the susceptibility of different varieties of apples to the attack of measles. In New Mexico the Jonathan is the most susceptible, although all varieties are more or less subject to the disease.

Considerable work has been done by the Experiment Station to determine the cause of apple measles, but so far nothing definite has been discovered as to its cause or remedy. Indications are that apple trees growing in ground containing considerable alkali are most subject to measles. Experimental work is being conducted to prove or disprove this fact. Grafting experiments do not indicate that measles is transmissible.

POWDERY MILDEW.—Powdery mildew is caused by a fungus that lives through the winter within the dormant buds and infects the new leaves and tender twigs, blossoms, and fruit in the spring. The first appearance of the disease is usually manifested by small grayish or whitish felt-like patches of mycelium on the under side of the leaves, these leaves becoming curled and wrinkled. The patches covered by the fungus rapidly enlarge, and generally the entire leaf becomes covered with mycelium and a powdery coating

of spores. The mildew spreads rapidly down the petiole of the leaf to the twig, which takes on a powdery appearance. Twig growth is soon checked, and in severe infection the twigs are killed. The effects of fruit infection are to dwarf the apple and produce a russeting of the skin beneath the fungous growth. In cases of severe infection, the formation of new fruit buds is prevented, and the following season is one of a light crop or no crop at all.

Pruning out infected shoots during the dormant season is an important step in control, but this treatment must be supplemented by spraying during the growing season. Liquid sulfur sprays should not be used as a summer spray on apples in New Mexico, as severe burning of foliage and fruit will result. Any of the following sprays will control apple, rose, or any of the powdery mildews:—

1. The most effective control for powdery mildews in general is through the application of sulfur dust. Dusting machines of types for all purposes are now on the market. Dusting may be begun with the first appearance of the disease, since this is one of the few fungi which can be killed after infection. A second application should be made about two weeks later.

2. Ammoniacal copper carbonate. Dissolve six ounces of copper carbonate in three pints of ammonia and dilute with fifty gallons of water. This solution loses strength on standing and must be prepared fresh each time it is needed.

3. Sal soda-Bordeaux. Dissolve separately four pounds of copper sulfate (in a wooden container), five pounds of sal soda, and two pounds of lime. Add, with agitation and in order given, to water in the spray tank, and make up to fifty gallons.

The use of a "spreader" is advisable with any of the liquid sprays. Special attention should be given the terminals and the under surfaces of the leaves, to see that these portions of the tree are sprayed thoroughly.

The first spray should be applied just before the blossoms open, the second as soon as most of the petals have fallen, the third about two weeks after the petals have fallen, the fourth about five weeks after the calyx spray. Later sprays may be applied, if necessary, at intervals of about three to four weeks until the latter part of August.

CROWN GALL.—Two distinct forms of the disease are recognized: galls and hairy root. The galls are in general somewhat globose, abnormal outgrowths of the woody tissue and vary in size according to age and conditions of growth. Mature galls are frequently several inches in diameter.

Hairy root was at one time considered as distinct from crown gall, but it is now known to be caused by the same organism. Fibrous roots in large numbers are produced at the crown and along the tap root. This gives a bushy appearance, quite characteristic

when well developed. Combinations of hairy root and crown gall and all gradations between the two occur.

Crown gall is caused by a bacterium. This is a very minute organism which lives in the soil as well as in the plant tumors. It is probably rather generally distributed in cultivated soil, since there are so many hosts in which it is able to live.

There is no satisfactory method of completely controlling this disease. Cutting off the galls is not reliable, since internal strands of the disease are usually present and cannot be removed. Sanitary methods in the nursery are essential. Care should be taken to avoid unnecessary wounding of stem and roots. Instruments used in grafting should be sterilized by dipping in mercuric chloride. If a large number of diseased plants are found in any part of a nursery, this part should be given over to field crops for several years before again using for nursery stock. The stock and scion should be carefully wrapped and dipped into a 25-25-50 Bordeaux mixture paste before placing the graft in the ground.

FIRE BLIGHT.—Fire blight is often referred to as "twig blight" when it attacks twigs of the current year, or "blossom blight" when it is especially destructive to blossoms. The term "spur blight" is used when the blight extends from blossoms or young fruit down into the fruit spur. "Blight canker" is the term used to distinguish the canker produced by this disease on the trunk or large limbs.

The first appearance of the blight in the spring is at blossoming time. Blossoms when in full bloom suddenly turn brown and wilt. A closer examination shows the disease extending down the pedicels of the fruit, turning them black or dark brown. Later the leaves below the flower cluster may become infected, quickly wilt, and die as a result of extension of the disease into the spurs. The leaves on the young twigs wilt and turn brown from the tip downward. The distance which the disease travels downward is dependent somewhat upon the variety and weather conditions. The leaves remain on the twigs, giving a decidedly scorched appearance to the tree.

The bacterium causing this disease lives over winter very rarely in cankers on the apple trees. "Hold over" cankers are more frequently produced on the pear and it is in these cankers that the disease lives from one year to another. A sticky substance is produced from these cankers in the spring. Bees and other insects carry this material, which contains millions of bacteria, to the blossom.

In States where fire blight causes great damage it has been entirely eliminated by not growing pears in the same locality with apples. The pear tree is the chief means by which the disease lives from one year to another. All blighted twigs and cankers should be

cut out, care being taken to disinfect thoroughly with mercuric chloride all tools used in the work. All wounds should be painted with a good quality of paint, to prevent the entrance of blight and other wood rotting fungi.

BEANS

BEAN ANTHRACNOSE.—The losses from bean anthracnose are due to poor germination of affected seed, to destruction of affected seedlings, to low yield of affected plants, and to decreased value of the product. The principal loss in the production of green beans is due to the spotting of the pods, which renders them unsalable as snap beans and unfit for canning. Southern-grown beans, apparently healthy when shipped, frequently reach northern markets in a badly spotted condition; and if the disease is common in the field, pods kept overnight after picking are likely to be rusted the next morning. The lesion may extend through the pod to the seed, discoloring it. The value of the dry seed thus affected is lessened, and the buyer usually deducts a certain percentage, the "pick", from the total weight, to allow for this depreciation. A poor stand often results from the planting of spotted seeds, many of which fail to germinate; and this result is aggravated by the destruction of seedlings subsequently affected. Plants that have survived the early attack may give an inferior yield, due to interrupted growth, although the pods themselves may not become spotted.

Upon the pods the disease appears as dark colored spots, usually sunken, varying in size. The border of the spot is often tinged with red, the center rust colored. Old pod spots overlying seeds within cause spots upon these seeds. The pod spots are much more noticeable and unsightly upon light colored than upon green pods.

Similar spots are found upon the stems and leaves. They are especially noticeable upon young stems still blanched and upon the seed leaves. On older leaves they may appear upon the veins, blackening and killing them and the leaf.

The wax varieties are especially susceptible, while lima beans are quite resistant. The Red Kidney also shows considerable resistance. It is claimed that resistance is a dominant Mendelian character.

The fungus is carried to fields largely by diseased seeds; by beans bearing the spots above mentioned. Such seeds result in affected seedlings which serve as a multiplying medium for the fungus and result in its spread and general attack upon the field.

In fields where the disease is well established upon the stems and leaves, the damage is great in loss of starch producing power. Still greater loss follows from the spread of the disease to the pods, the unsightliness of the spotted pods greatly injuring their salability.

Since the spores are spread only when they are wet, handling

or disturbing the vines in any way while the dew or rain is still upon them should be avoided. Seeds already bearing the fungus, i. e., spotted seeds, should never be planted; since they not only produce sick plants but carry the disease to the field to infect other plants. One infected seed may carry contagion to the field. Spraying is not effective. Since no remedy is at hand, except the use of healthy seed, the greatest care should be given to this point. Home, fall-grown seed known to be free from disease is preferable to seed of unknown origin. If a few seeds known to be free from disease can be secured and multiplied in a special seed plot, they will give clean seed for future use. Clean culture and the removal from the field and destruction of diseased stalks and plant parts, eliminate a source of spring infection which may be important.

BEAN BLIGHT.—Beans of various kinds are subject to a blight which manifests itself upon the pod, leaf or stem. It has been reported from various states and Canada, is widely distributed, and is often quite destructive.

Usually the leaves are the first parts attacked. Here large translucent patches, brown in color, are produced. These spots dry later, become papery in texture, and rupture, leaving the foliage ragged and torn.

On the pods, as on the leaves, minute dark green spots are the first indication of the disease. These gradually increase in size and assume a water-soaked appearance. In the first stages the larger water-soaked areas are neither raised nor sunken, but as the disease progresses tissues collapse and they may become slightly sunken. In cases of severe infection it is not unusual for this water-soaked area to cover an entire side of a pod. On many of the small water-soaked spots and on most of the larger water-soaked areas light yellow bacterial ooze appears. In small spots this ooze usually forms in the center, while in case of larger areas ooze may be present over the entire water-soaked surface as minute yellowish droplets. In some cases this bacterial exudate is present in such abundance as to cause the hands of the pickers to become sticky. The ooze gradually darkens and dries, forming a chrome yellow crust; or in other cases small lumps over the diseased area.

This disease is carried over the season largely by infected seed and is conveyed from plant to plant in the field by insects.

Diseased seed and seed from fields bearing the disease should be avoided, and clean culture, including the burning of all infected plant parts, should be practiced. The following list shows the variation in resistance, the least susceptible being placed first and the most susceptible last: Schindler's Round Pod Wax, Refuge Wax, Burpee's White Wax, Grenell's Rust-proof Golden Wax, Wardwell's Kidney Wax, Dwarf German Black Wax, Early Valentine.

BEETS

CURLY TOP.—The first symptom of the disease that appears in definite form is the rough angular or warty development of the veins on the under side of the leaf. This abnormal condition causes the leaf to curl up and knot-like swellings to occur at intervals on all veins, and especially at the junctions. If the disease appears early in the season it has a dwarfing effect on the whole plant, causing the leaves to turn in and fold up, forming a loose head. Later the plant turns yellow in color, shrivels and may die. In extreme cases the stems of the plant may crack open, allowing a liquid to escape to the surface, which upon evaporation leaves a deposit of sugar. The roots of affected plants show a large mass of fine rootlets. The disease develops best under hot, dry conditions.

Curly top is produced by the bite of the beet leaf hopper. The bite of the insect is not sufficient to produce the disease but the insect carries within its system some substance which when injected into the plant, brings about the diseased condition. The insect gets this substance into its system by biting a diseased beet. A leaf hopper which has never been upon a diseased beet may bite a healthy beet without producing the disease, but if it is on a diseased beet before it bites a healthy one, the disease will follow. No satisfactory method of control is known at present, with the exception that it is not advisable to thin the beets at the time when hoppers appear.

CABBAGE

BLACK ROT.—This at present is not a serious disease in New Mexico. Black rot makes its first appearance along the edges of the outer leaves. The progress of the disease from the point of infection can be traced through the veins of the leaf by the blackening of the bundles. The marginal infection is later followed by a browning and drying up of the infected area of the leaf. Much loss is often suffered in storage when slightly infected plants are stored. Infection may occur in the seedling stage, killing the entire plant in a very short time.

Black rot is a bacterial disease. The bacteria may gain entrance to the plant through the breathing pores or by mechanical injury, but they enter most commonly through the water pores along the margin of the leaves. The organism lives over winter in the soil and decayed cabbage refuse and also on seed from diseased plants.

Since infection takes place in the seed bed, the plants should be closely watched to see that no infected plants are taken to the field. Crop rotation is necessary for effective control. Seed should be disinfected by soaking in mercuric chloride (1-1,000) for fifteen minutes or formaldehyde (1-200) for twenty minutes.

BLACK LEG.—The earliest symptoms may appear in the seed bed two or three weeks before transplanting time. Infection usually occurs on the stem near the surface of the ground, causing dark sunken or irregular spots. From these spots the disease spreads, gradually killing the base of the plant and roots so the plant wilts and dies. Such wilting of the entire plant is characteristic of the advanced stages of black leg and the leaves adhere to the stem instead of falling off as in yellows. Frequently, plants attacked by black leg show a purpling of the leaves, as the first symptom.

Crop rotation and destruction of all infected plants are the most reliable control measures. Seed from a diseased field should never be planted unless thoroughly disinfected with mercuric chloride. Seed should never be planted in beds containing soil that has grown cabbage before.

CHILE PEPPER

CHILE BLIGHT OR WILT.—This disease is caused by a fungus which is found in most New Mexico soils. The disease can live in the soil indefinitely, feeding upon such organic matter and plant refuse as may be present there. When the chile is planted in these soils, the disease finds in it a food well suited to its needs.

A rapid wilting of the leaves and dropping of the younger shoots, followed by a general browning and drying of the foliage, constitute the characteristic signs of the disease. Wilting first affects the lower leaves, which curl perpendicularly to their midvein and droop; later the upper leaves are similarly affected. This process takes place in a very short time. The stems, on account of their woody nature, remain erect after the drooping and falling of the leaves.

The roots, underground stem, and often the lower part of the stem above ground may be attacked by the disease. Dark brown and sunken spots may appear at the base of the aerial stem of affected plants, and by a gradual circling movement they girdle the stem. The bark becomes dry and brown ,and the wood beneath is darkened. This darkness may be confined to the outermost layers alone, or it may involve all tissues.

When a newly wilted plant is dug and examined, a part of, or more commonly the whole underground stem, as well as a portion of the roots, will appear browned or blackened. The affected bark of the underground stem, especially in wet soils, is reduced to a dark mass of broken down tissues which easily rub off, exposing a smoke colored wood. When a wilted plant is pulled out of the ground the cork cambium peels off from the badly infested roots and remains in the soil. The diseased roots are dark brown, at first brittle, then soft and water-soaked; whereas the healthy roots are creamy in color, and strong and rigid in structure.

The general effect of the disease upon the chile crop is quite

striking. Groups of wilting and dead plants, some with a few of their shriveled, dry brown leaves still clinging to them, are very conspicuous in a field of green plants. The infected areas form various sized patches which gradually enlarge as the season progresses. If the plants are attacked early in the season, no fruit is formed and the plant is a total loss to the grower. If the disease does not appear until late summer, the pods can be harvested and sold as green chile. If left on the vines, they soon shrivel and fall off. In case the plants are not diseased until late summer, the green pods will mature after the death of the plant, but will lack the healthiness of the pods matured on healthy plants.

The greatest single controlling factor in the occurrence and the severity of this disease appears to be the soil moisture. It has been a matter of common observation that the wilt of chile pepper is most serious in low, wet fields, on crops growing in heavy or clay soils, and on undrained land. Heavy rains and general outbreaks of chile wilt seem to go hand in hand. The records show that the wilt was very destructive in 1923, when considerable rainfall occurred, and not so serious in 1924, which was a drier year.

Since there is a close correlation between the high moisture content of the soil and the wilt of chile pepper, it follows that anything which will check the soil moisture will also check the disease. In the first place, heavy soils should be avoided and light soils given preference, as far as possible. Too much emphasis cannot be placed upon an intelligent practice of irrigation. Investigational work conducted by the Experiment Station indicates that irrigation at intervals of twelve days produces the smallest number of wilted plants and the largest yield of chile per plant.

CORN

SMUT.—The disease may attack any part of the corn plant at any age; leaves, stalk, aerial roots, ears, tassel; provided that they be still in a tender, growing condition.

The first symptom is a pale, swollen area covered with a white membrane, which soon becomes black owing to mature spores within. Millions of spores are contained in these smut masses and are scattered by the wind.

It has been proved that the disease is not conveyed to the new crop in the seed, and therefore no form of seed treatment is of value as a prevention. It has also been shown that smut spores may pass through the digestive tract of animals uninjured. For this reason only well rotted manure should be placed on corn land. Since the spores live in the soil, crop rotation is advisable.

CHERRY

BLACK KNOT.—The disease is confined to the woody part of the tree, causing black, swollen, wart-like knots extending for sev-

eral inches along the twigs and branches. The knots are greenish in color and quite soft when first formed, but become coal black and hard later in the season.

The knots are caused by a fungus which invades the tissues of the branches and stimulates the production of cells to such an extent as to form galls. The knots are made up partly of fungous growth and partly of deformed tissues of the twig.

Black knot once established in an orchard is difficult to control. Promptness in cutting out and burning the knots as soon as they become evident in the autumn or early winter is perhaps the most effective way to eradicate the disease. Badly diseased trees should be cut and burned. Spraying with 4-4-50 Bordeaux mixture has been recommended in some parts of the country. The applications should be begun the latter part of March and continued at least through April. They should be about two weeks apart.

CHLOROSIS

Many plants of all kinds will be found to have light yellow foliage instead of the normal green. This deviation from a normal green to a sickly yellow color is called chlorosis. This yellowed condition of the foliage is to be found on practically all crops that are grown in the State, although it is more severe in some parts of the State than others.

It is generally believed that chlorosis is not caused by a fungus but is due to a lack of certain plant food elements in the soil. Plants that are attacked by certain of the root borers often show this chlorotic condition.

The green color of leaves is due to the presence of a coloring matter in the leaves called chlorophyll. This chlorophyll is necessary for the manufacture of plant food. Plants that lack chlorophyll are unable to manufacture plant food and as a result become stunted and soon die. The dry, arid climate, with its sand and dust storms, apparently affects the ability of the chlorophyll to function, as it has been noticed that following a washing rain the trees recover somewhat. Experiments conducted show that the stomata, or breathing pores of the leaves, become clogged during dust storms.

The use of iron sulfate to correct the chlorotic condition so common in plants all over the State, gives indication of being at least a temporary remedy for this condition. Holes are bored in the chlorotic trees and a small amount of iron sulfate put into these holes. In about three weeks the trees begin to show a decided change in the color of the leaves, changing from a yellowish to a healthy green color. Further work will be done to determine the correct dosage for certain sized trees and observations conducted to find out if this remedy is permanent or merely temporary.

COTTON

ANGULAR LEAF SPOT.—The disease is most conspicuous upon the foliage leaves, but occurs upon the cotyledons, petioles, bracts and bolls. The spots appear first on the lower side of the leaf, and then penetrate to the upper side. In the early stages they appear as dark green water-soaked spots. Later the diseased tissue turns brown. The disease appears in the spring as soon as the plants come out of the gound and may be seen on the seed leaves as circular spots which have the appearance of having been water soaked.

Very commonly a yellow gummy substance exudes from the diseased spots. The infection often follows a vein of the leaf, making a zigzag line along each side. Leaf petioles are killed, causing the leaves to die and dry up. Badly spotted leaves usually fall early.

On the bolls the disease appears as dark green water-soaked, raised circular spots, which may become dark brown and sunken in the center, especially when invaded by secondary rots. The organism may penetrate the boll and cause a staining of the lint, but does not itself cause a rot. However, the disease breaks down the tissues of the bolls and allows other boll rotting fungi to enter.

Angular leaf spot is a bacterial disease and lives over winter probably almost entirely on the short lint of cotton seed. The disease is controlled by delinting the cotton seed with sulfuric acid.

The use of concentrated sulfuric acid to delint cotton seed infected with angular leaf spot has proved a success in many of the older cotton growing States. As soon as it was discovered that the disease passes the winter in the lint, it at once became evident that if the seed was delinted before it was planted, danger from this source would be eliminated. The treatment of cotton seed is complicated by the presence of the lint, which, because of the air it holds, prevents the ordinary disinfectants, such as bichloride and formaldehyde, from coming in contact with the surface of the seed and thoroughly sterilizing it. For this reason it becomes necessary to use a concentrated sulfuric acid, testing around 64 to 66 degrees Baumé, to remove the lint. The New Mexico Experiment Station has had inquiries regarding the use of a 60 degree Baumé acid for delinting cotton seed. This strength of acid should not be used, as it removes only a small part of the lint. The remaining lint becomes packed by the action of the acid, and it is almost impossible to wash the seed free from acid. The effect of this acid remaining in the lint is apt to injure germination.

While the prime consideration has been one of disease control, an incidental but very important feature is presented in the possibility of saving a large part of the seed usually planted. Since the de-

linted seed is entirely smooth, it can be handled like corn or peas and planted more uniformly by machinery. Another important advantage of delinting is that the seed will germinate at once, if there is sufficient moisture in the ground at the time of planting. In some cases, in other States, this has given delinted seed two weeks' start over undelinted seed planted in adjacent rows. Other States report an increase in the amount of lint and also more pounds of lint at the first picking, by the use of delinted seed. The delinting process is as follows:—

Equipment: 1. Six or eight strong tubs (made from sound half barrels) provided with iron handles. The bottoms of two of the tubs should be bored full of half-inch or three-fourths inch holes for draining off the acid. 2. Screen wire cut to fit the bottom of the strainer tubs, to prevent loss of seed in washing. 3. Several barrels to hold a reserve supply of water. 4. Plenty of running water and a ditch to carry off the wash water. 5. A supply of 66-degree commercial sulfuric acid. 6. Some strong poles to stir the seed in the acid. (For small amounts earthenware crocks could be used.)

Procedure.—A bushel to a bushel and a half of seed is put in one of the tubs and enough acid poured over it easily to "wet" the seed when it has been thoroughly stirred. Stirrings should continue until the seed is entirely black. The strainer tub is put over the second tub full of seed and the delinted seed poured into it, allowing the acid to drain through on to the second tub of seed. When most of the acid is drained off the seed is emptied into another tub and the acid "drowned" by pouring on two or three buckets of water. This is the most critical part of the operation, for the temperature of the mass of seed will become high enough to injure germination if sufficient water is not added to keep it cool. The seed is thoroughly stirred in the water, then emptied into the second strainer tub and washed until it is no longer sour to the taste. This takes considerable water and stirring. The seed is then ready to be spread out to dry, after which it may be placed in clean or disinfected sacks. The acid may be used until it will no longer run off the seed, when it must be washed out with plenty of water. After delinting, the seed can be put through a fanning mill and all faulty and light seed removed, so that when planted, practically a 100% germination should be obtained.

One gallon of acid will treat one bushel or more of seed. Commercial sulfuric acids cost around four cents a pound. Care must be exercised to avoid burning shoes and clothing with the acid. Rubber and oilcloth are not injured by it. An application of axle grease on the hands and arms will prevent burning by the acid.

The New Mexico Experiment Station does not advise that all cotton seed be delinted, as it is not known how much advantage can

be obtained in New Mexico by the use of delinted cotton seed. It does advise farmers to try out this method on a small scale so that they may satisfy themselves that the method is practical.

SORE SHIN.—The disease commonly called sore shin attacks chiefly the small cotton seedlings, causing them to rot off partly or entirely at or near the surface of the ground. It sometimes causes considerable damage during cool, wet periods early in the season, by reducing the stand of plants or by so injuring the seedlings that the development of the crop is delayed and the growth retarded. It rarely causes important damage in favorable seasons, owing to the practice of very heavy seeding.

The trouble is characterized by the presence of dark, rusty brown sunken cankers on the seedling stems or at the joint just below the surface of the soil. In severe cases these encircle the stem or penetrate so deeply that the plants fall over and die. Many plants which have stem cankers but are not too severely affected recover on the arrival of warm, dry weather and outgrow the injury, though somewhat delayed in development.

Sore shin is caused by a fungus that lives in the soil and attacks the seedlings during cool, moist weather. By reason of the nature of the injury, many farmers attribute the trouble to cuts or blows from a hoe or scraper.

No very satisfactory control measures are known. The best practice is to cross harrow the rows with a weeder to allow the soil near the seedling stems to dry out as quickly as possible after wet periods.

GRAPES

BLACK ROT.—This disease attacks the leaves and shoots, as well as the young fruit. It usually makes its first appearance on the leaves and young shoots, producing reddish-brown dark spots. The disease may attack the blossoms or young fruit, but usually it does not attract much attention until the vines are half grown or more. Livid or brownish soft spots first appear; these spread and soon involve the whole berry, which later becomes black and shriveled or mummied. These diseased berries remain attached to the bunch and their surface becomes covered with minute black pustules.

To prevent infection of black rot, clean culture should be practiced. All mummied fruit should be burned, to avoid infection. The ground should be kept free from weeds and grass. About a week before the blossoms open, or when the new shoots are from 12 to 18 inches long, a spraying with 4-3-50 Bordeaux mixture, to which 2 to 3 pounds of arsenate of lead have been added, should be given. A second application should be applied just after the blossoms fall. A third application should be applied two weeks later, using 4-3-50

Bordeaux mixture, arsenate of lead 2 to 5 pounds, one-fourth pint of 40 per cent nicotine sulfate, and one pound of resin fish oil soap to fifty gallons of spray mixture. This spray will control both black rot and certain insects, as the berry moth, leaf hopper and grapevine aphis.

PEACH

BROWN ROT.—Brown rot is perhaps the most destructive disease of the peach in New Mexico. It affects all stone fruits, including the plum, apricot, cherry and almond. The greatest damage is done to the fruit, although the blossoms and twigs may be affected. As a rule, the rot appears first near a wound or insect puncture, but as the fruit nears maturity, its susceptibility to attack increases and spots may appear on apparently sound surfaces. The spots are at first small, circular, grayish-brown decayed areas which rapidly increase in size. When the spot has involved a considerable portion of the peach, gray tufts develop on the surface. After the entire fruit has rotted, it gradually shrinks into a black mummy covered with an ashen powdery mass. The disease passes the winter in these dead and decayed peaches called mummies.

Brown rot may be controlled by spraying and orchard sanitation. Mummies should be removed from the trees when pruning. The trees should be sprayed with self-boiled lime sulfur about seven or eight weeks before the fruit is expected to ripen. It is unsafe to use commercial lime sulfur, as burning of the foliage will result.

POTATOES

Many potato diseases are carried in or on the seed tubers; as seed is brought in from other sections the diseases of those regions are introduced into the State. These diseases once established in the soil are increasing yearly, with repeated plantings of potatoes.

The potato thrives best in a fairly cool climate. The plants lose their vigor and the tubers are not suitable for seed purposes when grown in very hot sections. The chief seed potato producing States are thus found along the northern border of the United States. Upon these sections the Southern States depend for their seed potatoes.

FUSARIUM WILT.—This is a hot weather disease and is consequently found only in those potato growing sections in which high air and soil temperatures prevail during the growing season.

It is primarily a vine disease, characterized by a blighting or wilting of the vines; and is accompanied by a general browning of the water vessels of the stem, and less regularly by the browning of the water vessels of the tuber. Usually the discoloration is confined to the stem end, but at times it extends throughout the length of the tuber and is traceable into the eye.

The presence of the disease can be detected, in otherwise normal

tubers, only by making a thin slice across the stem and searching for the brown discoloration. Such potatoes are undesirable for seed and can be used for food.

Since fusarium wilt may come from the soil or the seed pieces, its prevention is a very difficult matter. Rotation of crops and the use of uninfected seed potatoes are the present recommendations. Seed treatment has no effect on this disease.

COMMON SCAB.—This disease is known to exist in every potato growing section in the United States. It manifests itself in the form of hard, brown, rounded, corky spots on the surface of the tuber. The scab spots may be separate or may run together, sometimes covering almost the entire tuber. Scab varies in appearance and type from a deep to shallow or even raised forms. Common scab is particularly severe in alkaline soils, but causes little, if any, damage in acid soils. The rough-skinned russet varieties appear to be more resistant than the thinner white-skinned varieties. The fungus causing the disease persists in the soil, and the infection of a new crop may come either from infested soil or from diseased, untreated seed.

Tubers badly disfigured by scab should not be planted. Mildly infected potatoes may be treated either with formaldehyde or corrosive sublimate. If the soil is infected, tuber treatment will not prevent scab. In such cases sulfur may be applied at a rate and in a manner which must properly be worked out for existing local conditions. Wood ashes, lime, and stable manure all promote scab and therefore should not be used on the potato crop unless the soil is acid enough to offset the effect of these materials. If no effective soil treatment is available, and the soil be infected, the more scab-resistant russet varieties may be substituted for the smooth varieties.

ROSE

BLACK SPOT.—Both in- and outdoors this is a widely known and destructive disease of the rose. It consists of irregular circular or oval indefinitely bordered black spots upon the upper surface of the leaves that are mature or nearly so. These spots usually appear late in the spring or early in the summer. The spots are small at first, but increase in size as the disease progresses. Later a number of them coalesce and, in severe attacks, the entire leaf may be covered with large dark patches. In the latter part of the season, the spots frequently grow light in color and dry in the center, showing this part of the leaf to be dead. Very commonly the leaf tissue adjacent to the black spot becomes chlorotic before the leaves fall from the plant, and not uncommonly all of the uninvaded tissue becomes yellow before the defoliation occurs. Premature defoliation is one of the most pronounced features of this disease.

The fungi live over winter in fallen leaves. These leaves should be carefully collected and burned late in autumn. When a rose

garden consists of only a few plants, much may be accomplished by picking and burning every leaf as it shows signs of the disease.

Protection by spraying is the usual recommendation for the control of this disease. Of the numerous fungicides recommended, probably Bordeaux mixture and ammoniacal copper carbonate are the two most commonly used. The latter is to be preferred, as it does not leave any sediment on the leaves of the plants. This solution is prepared as follows:—

Copper Carbonate	6 ounces
Ammonia	3 pints
Water	50 gallons

The proper amount of copper carbonate should be weighed out, a very small portion of it set aside, and the remainder dissolved in dilute ammonia; using only enough ammonia to dissolve it. Then the portion of the copper carbonate which was reserved should be added. This will insure the use of no more ammonia than is necessary. The solution should be diluted to fifty gallons and applied as a fine spray, covering all the leaves carefully.

TOMATO

TOMATO LEAF SPOT.—The disease first appears on the older leaves of a plant. The first indication of its presence is the formation of a small, almost indistinguishable water-soaked area on the under leaf surface. As the disease progresses, these areas become more definte in outline and the tissue becomes dry. Many spots frequently join together. When this condition is reached the intervening green tissue soon dies, the leaf remaining on the plant in this condition until removed by wind or other agencies. In case of heavy infection, it is not uncommon to find plants bare of all living leaves except a few newly formed leaves at the apex.

The overwintering of the leaf spot of tomatoes can be prevented largely by plowing under the old tomato vines in the autumn. This fungus overwinters chiefly in the old vines but cannot live until spring in the soil. Plowing under the vines in the fall therefore kills it.

Tomato leaf spot also grows and produces spores on dead weeds, grasses and the remains of various crops, especially cornstalks. Keeping these dead materials covered with soil by plowing or cultivating, robs the fungus of its food supply and increases its difficulty of living from year to year as a saprophyte.

The destruction of horse nettle, Jimson weed, and nightshade, on which the leaf spot lives as a parasite, the burning of dead weeds and grasses along fence rows and in other waste places, and the practice of clean culture generally will aid in the control of this disease.

The use of Bordeaux or other copper spray mixture has given

the most effective control of leaf spot in the past, but the profits from spraying are variable and not always sufficient to justify the expense. A more effective and economical method of control lies in the use of modified field practices, as given above.

FUSARIUM WILT.—Wilt is characterized in its earlier stages by a wilting of the plant and an upward and inward rolling of the leaves. Later the lower and finally the upper leaves turn yellow and slowly die. When a branch is thus deprived of its foliage it dies back from the tip, turns brown, and shrivels.

In a cross and longitudinal section of infected stems, there is a dark brown discoloration in the woody area between the pith and bark. By means of the discolored tissues, infection can be traced through the fruit stem into the fruit and even to the seeds.

It has been proved that tomato wilt lives from one year to another in and on tomato seed and that it comes from infected plants, as well as in the soil. The only means of controlling wilt successfully has been developed in recent years. As the wilt fungus lives in the soil and invades the tomato plants through its roots, it lies beyond the reach of chemical sprays, such as Bordeaux and other mixtures commonly used for the control of fruit and foliage parasites. It multiplies rapidly in the tomato plant, as it has no competition for its food supply and becomes thoroughly distributed through the soil with the plowing under of dead vines. If a piece of wilt-infected land be used successively for growing tomatoes it soon becomes so full of the fungus that ordinary varieties of tomatoes cannot be grown on it. Rotation of crops forces the wilt fungus to compete with other fungi for its food and therefore reduces it to a minimum, but so far as known, it does not eradicate it; as it is capable of living long periods, if not indefinitely, on organic matter in the soil. Treating the soil with chemicals has not given results of economic value. The only successful means of controlling wilt is through the development of resistant varieties.

Three varieties of tomatoes developed by Dr. F. G. Pritchard of the United States Department of Agriculture, produce heavy crops of excellent fruit on land so heavily infected by wilt that ordinary tomatoes cannot be grown. They are selections from Greater Baltimore, Stone, and Mawl of the Market, three of the best commercial varieties of tomatoes grown; and possess in addition to wilt resistance all of the good qualities of their parent varieties.

MOSAIC

The mosaic disease occurs on a wide range of cultivated plants, as tobacco, potatoes, tomatoes, sweet potatoes, muskmelon, lettuce, turnips, peppers, cucumbers, and cowpeas; also on wild or uncultivated plants, as wild tobacco, milkweed, horse nettle, bittersweet, Jimson weed, ground cherry, and nightshade.

The damage resulting from mosaic is twofold; first, the plants,

when severely atacked, are stunted and dwarfed. Secondly, the yield from the plants attacked is reduced.

Mosaic produces a mottled appearance of the leaves, due to variations in texture and greenness; parts of the leaf showing full green and normal thickness, other spots pale or yellowish-green and thin. Accompanying these signs are distortions due to unequal growth, wrinkled or curled leaves, and leaves of one-sided growth. The fruit from diseased plants is small and may be mottled or distorted.

This disease lives from one year to another in the roots of certain wild perennial plants. It is transmitted chiefly by insects, and in tobacco by topping.

Control measures consist in eradicating all perennial wild plants that act as host plants, and keeping down aphids and other insects that attack susceptible plants.

WATERMELONS

FUSARIUM WILT.—The cause of wilt is a fungus which attacks only watermelons. It lives in the soil, enters the small roots, and grows up through the water vessels, which it plugs to such an extent as to cause the vines to wilt. It has a preference for light, sandy soils.

There is no outside spotting nor are there any lesions to indicate the presence of the wilt. The source of trouble is confined entirely to the interior of the stems and roots. The leaves of an affected plant suddenly droop; this is followed by a rapid wilting of all the vines in that hill, from which they never recover. Wilting is more intense during a warm, dry spell. In pulling out a plant that has wilted or died, it will be noticed that the outside has a dull yellowish color. If the stem is cut the woody portion will be found to be discolored and browned. These brown areas are the water-carrying vessels which are plugged with the colorless filaments of the wilt fungus.

Control measures consist of rotation of crops and the use of wilt resistant varieties. A wilt resistant variety, named Conqueror, has been developed by the Department of Agriculture.

ROOT KNOT.—The watermelon is very susceptible to injury by the root knot nematode, a pest widely distributed in the South on most vegetables, cotton, cowpeas, tomatoes, beets, etc.

The above ground effect of root knot is mainly a stunting or reduction in vigor of the vines and size of fruit. The roots are the parts of the plants attacked and these are greatly swollen, distorted and knotty.

Root knot is a pest especially of old fields. Growers should bear in mind the susceptibility of this crop to root knot whenever considering the planting of old fields. Root knot can be controlled

in a practical way only by rotation with non-susceptible crops, such as winter grains, corn, velvet beans, and Iron cowpeas.

ANTHRACNOSE.—This disease affects the leaves and vines, as well as the fruit. Irregular dark dead spots appear on the leaves, which dry up and die prematurely. The stems may be spotted in a similar way.

The melons may develop spots, at first water-soaked and later sunken and covered with a pink growth of the disease. Hundreds of these spots of varying size may appear on a single fruit; at first shallow, they become deeper and result in the decay of the flesh when followed by other fungi. In any case the melon is disfigured and its market value much lessened.

Anthracnose is caused by a fungus widely prevalent, not only on watermelons but also on cucumbers, cantaloupes, and other plants of the cucumber family. The fungus has a peculiar ability to remain dormant in the melon rind and develop into visible spots later when heat and moisture are favorable; consequently, the disease often appears almost overnight on whole carloads en route to market. The original infection, however, is to be traced back to the field where the foliage was blighted.

Anthracnose can be prevented by spraying with Bordeaux mixture, if it be done thoroughly and at the proper time. In seasons when the disease is severe, two or three applications will save the crop. One hundred gallons of 4-4-50 Bordeaux mixture an acre are required for thorough spraying.

WHEAT

BUNT, STINKING SMUT.—This smut is readily distinguished from loose smut by the fact that it attacks only the grain, not the enclosing chaff. The heads, therefore, remain of much more nearly normal appearance, and it is often not until the glumes have been opened and their contents examined, that the presence of the smut mass is detected. It may be recognized by its peculiar, penetrating odor and by the deeper green color of the diseased heads.

The disease is very destructive, since its presence signifies not only the loss of grain due to smut, but also a depreciation in the value of the good wheat. Often bunted wheat is unfit for milling purposes.

Treatment consists of treating the seed with various chemicals, such as formaldehyde and copper sulphate, either as a liquid or as a dust. Directions for treating wheat with formaldehyde are as follows:—

Clean the seed thoroughly by fanning, so as to remove all possible smut balls. Immerse in a solution of one pint of formaldehyde to forty gallons of water for ten minutes. The copper carbonate dust treatment has given very good results where used. It consists of

placing the grain in a tight sack and thoroughly mixing two ounces of copper carbonate dust with each bushel of grain.

LOOSE SMUT.—Loose smut differs from the above in that the disease lives not only on the outside of the seed but internally. For this reason, seed treatment of wheat having loose smut has no effect. While stinking smut attacks only the grain, the loose smut destroys both the grain and the glumes or chaff. A loose mass of dusty spores is formed about the time the wheat should be in blossom. Since the fungus lives inside the grain, the usual formaldehyde treatment, which kills external spores, is not effective. The best remedy lies in the use of uninfected seed, but to obtain such is not always possible. A seed treatment known as the "modified hot water treatment" is very effective, but is difficult to apply and is slow. This treatment will be found practicable in treating small amounts of seed which can be sown in the seed plot for use as seed the following year.

The modified hot water treatment consists of the following procedure:—

The seed is placed in loose sacks filled only half full, and soaked from five to seven hours at room temperature. Two tubs or vats of water should be used. In one tub the exact temperature required should be maintained, while the other is used only in bringing the grain to the temperature of the treatment, so as not to lower the temperature. The drained sacks should be placed in tub 1 for a short time, then transferred to tub 2 for the length of time specified. The action of the heat should terminate as quickly as possible, and a cold dip is advisable, applied immediately after the grain has heated the required length of time. The temperature of the water should be between 124 degrees and 129 degrees Fahrenheit, and the time that the grain should be allowed to remain in the water should not be over ten minutes.

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